

# Tempsonics®

Magnetostrictive Linear Position Sensors

## R-Series V RH5 Analog Data Sheet

- Direct analog output, position + speed
- Dual magnet position measurement
- Field adjustments and diagnostics using the new TempoLink smart assistant



I AM THE NEW GENERATION

## MEASURING TECHNOLOGY

The absolute, linear position sensors provided by MTS Sensors rely on the company's proprietary Temposonics® magnetostrictive technology, which can determine position with a high level of precision and robustness. Each Temposonics® position sensor consists of a ferromagnetic waveguide, a position magnet, a strain pulse converter and supporting electronics. The magnet, connected to the object in motion in the application, generates a magnetic field at its location on the waveguide. A short current pulse is applied to the waveguide. This creates a momentary radial magnetic field and torsional strain on the waveguide. The momentary interaction of the magnetic fields releases a torsional strain pulse that propagates the length of the waveguide. When the ultrasonic wave reaches the end of the waveguide it is converted into an electrical signal. Since the speed of the ultrasonic wave in the waveguide is precisely known, the time required to receive the return signal can be converted into a linear position measurement with both high accuracy and repeatability.

## R-SERIES V Analog

Temposonics® R-Series V brings very powerful sensor performance to meet the many demands of your application. The R-Series V is the long term solution for harsh environments that have high levels of shock and vibration. Sensor models with analog outputs (voltage/current) have options for one or two position magnets, and for single or dual output channels.

When the R-Series V Analog sensor is ordered with a single output channel for one position magnet, the output will be the measured position value presented in either voltage or current.

When the sensor is ordered with dual output channels the second output can be configured to report the position of the second magnet or the reverse position or velocity of one magnet or the temperature inside of the electronics housing. Other configurations can be adjusted using the TempoLink smart assistant.

With many outstanding features the R-Series V sensors are fit for a very broad range of applications.

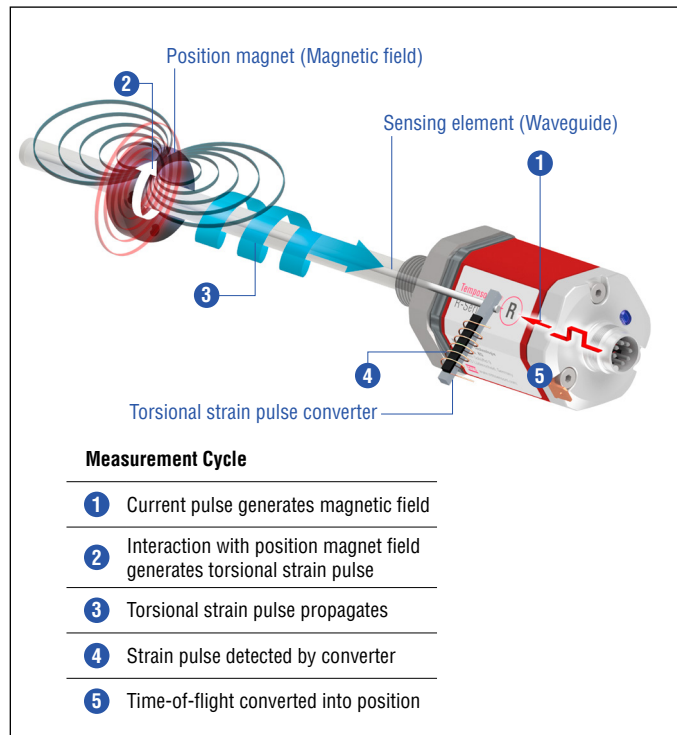


Fig. 1: Time-of-flight based magnetostrictive position sensing principle

## TempoLink YOUR SMART ASSISTANT

The TempoLink smart assistant is an accessory for the R-Series V family of sensors that supports setup and diagnostics. For the R-Series V Analog model, it enables the adjustment of parameters like the output values for the zero and span setpoints and their locations on the sensor. For diagnostics and analysis of operational data the R-Series V sensors continuously track values such as total distance traveled by the position magnet, internal temperature of the sensor and the quality of the position signal. This additional information can be read out via TempoLink smart assistant even while the sensor remains operational in the application.

TempoLink smart assistant is connected to the sensor via the power connection, which now adds bidirectional communication for setup and diagnostics. The TempoLink smart assistant is operated using a graphical user-interface that will be displayed on your smartphone, tablet, laptop or PC. Just connect your Wi-Fi-enabled device to TempoLink Wi-Fi access point and go to the website URL for the user-interface.



Fig. 2: R-Series V sensor with TempoLink smart assistant

## TECHNICAL DATA

Output					
Analog	Voltage: 0...10 /10...0/-10...+10/+10...-10 VDC (min. controller load > 5 kΩ) Current: 4(0)...20/20...4(0) mA (min./max. load 0/500 Ω)				
Measured output variables	Position for one or two position magnets. Position + speed (magnitude) or velocity (with direction) for one position magnet. Sensor temperature inside the sensor electronics housing.				
Measurement parameters					
Position measurement					
Null/Span adjustment	100 % of electrical stroke				
Resolution	16 bit (internal resolution 0.1 μm)				
Linearity deviation <sup>1</sup>	< ±0.01 % F.S. (minimum ±50 μm)				
Repeatability	< ±0.001 % F.S. (minimum ±1 μm)				
Hysteresis	< 4 μm				
Update time	Stroke length	≤ 1200 mm	≤ 2400 mm	≤ 4800 mm	≤ 7620 mm
	Update time	0.5 ms	1.0 ms	2.0 ms	5.0 ms
Velocity measurement					
Range	0.01...10 m/s or 1...400 in./s				
Deviation	≤ 0.05 %				
Resolution	16 bit (minimum 0.01 mm/s)				
Operating conditions					
Operating temperature	-40...+85 °C (-40...+185 °F)				
Humidity	90 % relative humidity, no condensation				
Temperature coefficient	< 30 ppm/K				
Ingress protection	IP67 (connectors correctly fitted)/IP68 for cable outlet				
Shock test	150 g/11 ms, IEC standard 60068-2-27				
Vibration test	30 g/10...2000 Hz, IEC standard 60068-2-6 (excluding resonant frequencies)/ RH5-J: 15 g / 10...2000 Hz, IEC standard 60068-2-6 (excluding resonant frequencies)				
EMC test	Electromagnetic emission according to EN 61000-6-3				
	Electromagnetic immunity according to EN 61000-6-2 The sensor meets the requirements of the EC directives and is marked with <b>CE</b>				
Operating pressure	350 bar (5,070 psi)/700 bar (10,150 psi) peak (at 10 × 1 min) for sensor rod/RH5-J: 800 bar (11,600 psi)				
Magnet movement velocity	Any				
Design / Material					
Sensor electronics housing	Aluminum (painted), zinc die cast				
Sensor flange	Stainless steel 1.4305 (AISI 303)/RH5-J: Stainless steel 1.4305 (AISI 303)				
Sensor rod	Stainless steel 1.4306 (AISI 304L)/RH5-J: Stainless steel 1.4301 (AISI 304)				
Stroke length	25...7620 mm (1...300 in.)/RH5-J: 25...5900 mm (1...232 in.)				
Mechanical mounting					
Mounting position	Any				
Mounting instruction	Please consult the technical drawings on <a href="#">page 4</a>				
Electrical connection					
Connection type	1 × M16 male connectors (6 pin) or cable outlet				
Operating voltage	12...30 VDC ±20 % (9.6...36 VDC)				
Power consumption	< 3.25 W				
Dielectric strength	500 VDC (DC ground to machine ground)				
Polarity protection	Up to -36 VDC				
Overvoltage protection	Up to 36 VDC				

1/ With position magnet # 251 416-2

## TECHNICAL DRAWING

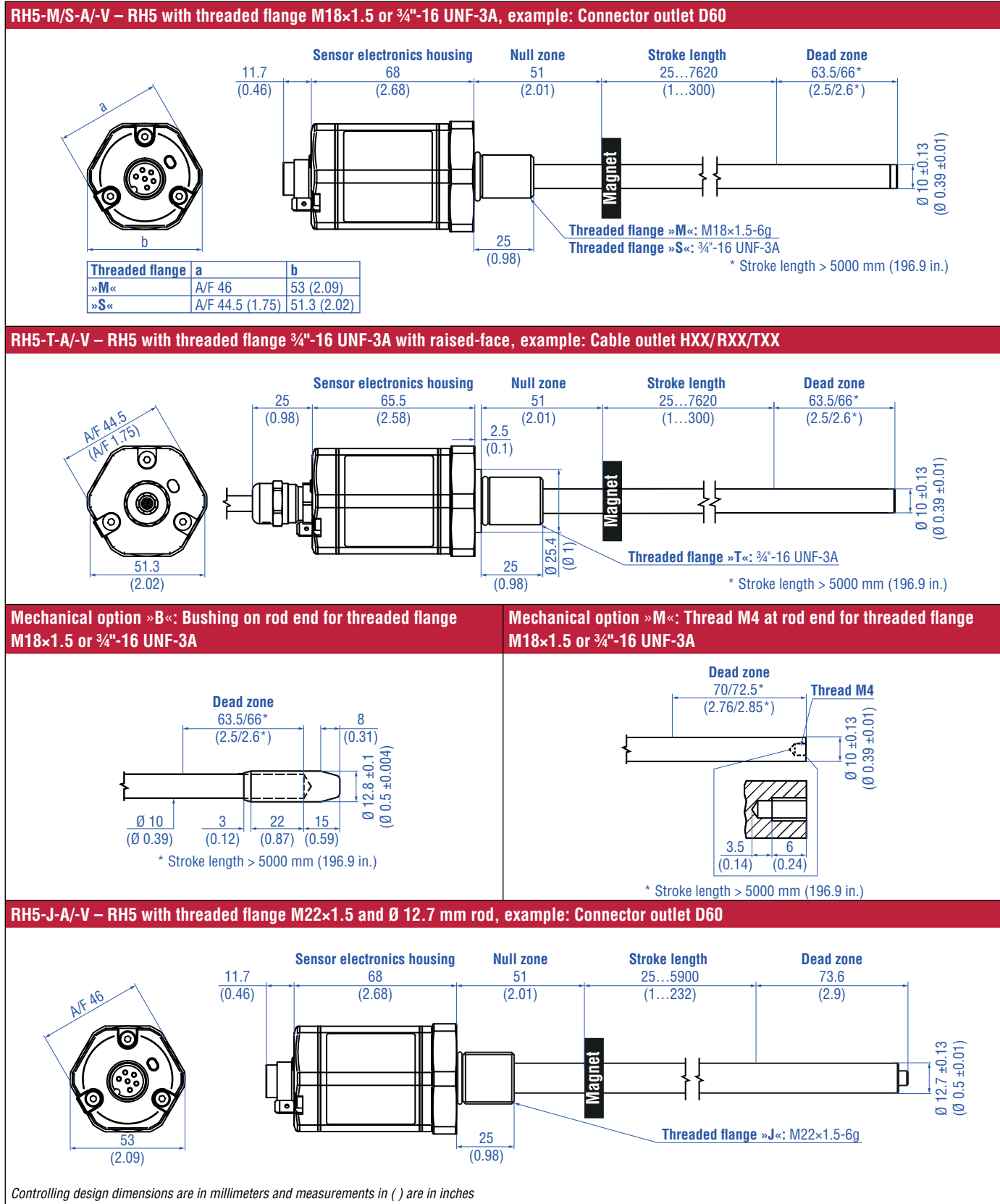


Fig. 3: Temposonics® RH5 with ring magnet

## CONNECTOR WIRING


D60			
Signal + power supply			
M16 male connector	Output	Pin	Function
 <p>View on sensor</p>	1	1	Position (magnet 1)
		2	Signal Ground
	2*	3	Position (magnet 2) or reverse position (magnet 1) or speed or velocity (magnet 1) or temperature inside the sensor electronics housing
		4	Signal Ground
		5	+12...30 VDC (±20 %)
		6	DC Ground (0 V)
* order dependent			

Fig. 4: Connector wiring D60

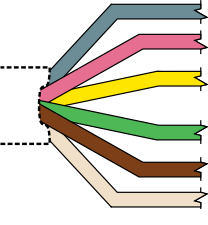
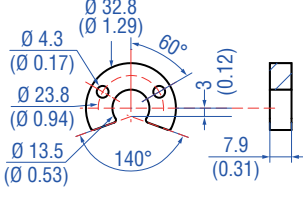
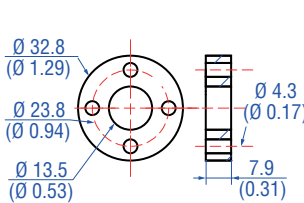
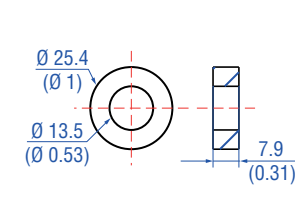
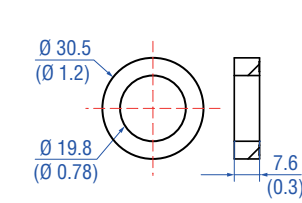
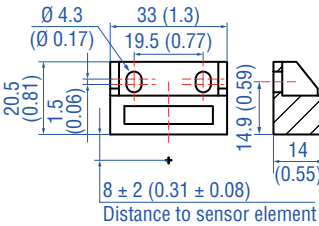
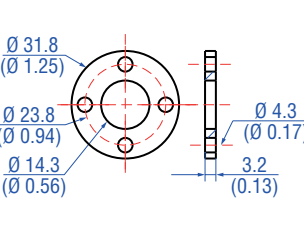
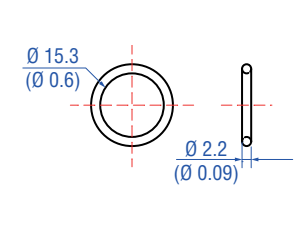
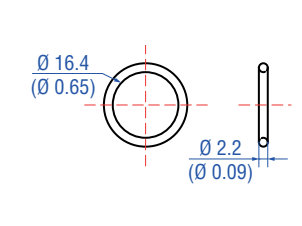
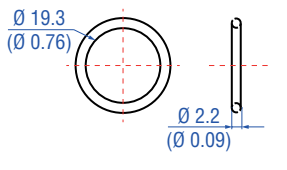
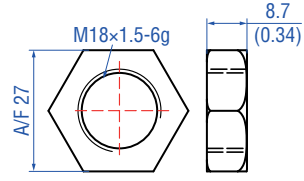
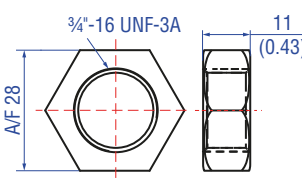
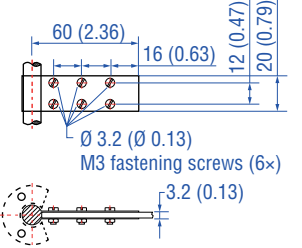
HXX / RXX / TXX			
Signal + power supply			
Cable	Output	Color	Function
	1	GY	Position (magnet 1)
		PK	Signal Ground
	2*	YE	Position (magnet 2) or reverse position (magnet 1) or speed or velocity (magnet 1) or temperature inside the sensor electronics housing
		GN	Signal Ground
		BN	+12...30 VDC (±20 %)
		WH	DC Ground (0 V)
* order dependent			

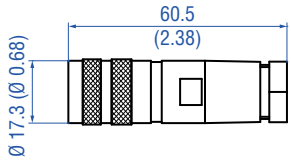
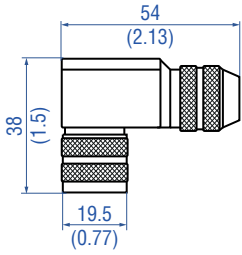


Fig. 5: Connector wiring for cable outlet

**FREQUENTLY ORDERED ACCESSORIES** – Additional options available in our [Accessories Guide](#)  [551444](#)

Position magnets					
					
<p><b>U-magnet OD33</b> Part no. 251 416-2</p>	<p><b>Ring magnet OD33</b> Part no. 201 542-2</p>	<p><b>Ring magnet OD25.4</b> Part no. 400 533</p>	<p><b>Ring magnet</b> Part no. 402 316</p>		
<p>Material: PA ferrite GF20 Weight: Approx. 11 g Surface pressure: Max. 40 N/mm<sup>2</sup> Fastening torque for M4 screws: 1 Nm Operating temperature: -40...+105 °C (-40...+221 °F)</p>	<p>Material: PA ferrite GF20 Weight: Approx. 14 g Surface pressure: Max. 40 N/mm<sup>2</sup> Fastening torque for M4 screws: 1 Nm Operating temperature: -40...+105 °C (-40...+221 °F)</p>	<p>Material: PA ferrite Weight: Approx. 10 g Surface pressure: Max. 40 N/mm<sup>2</sup> Operating temperature: -40...+105 °C (-40...+221 °F)</p>	<p>Material: PA ferrite coated Weight: Approx. 13 g Surface pressure: Max. 20 N/mm<sup>2</sup> Operating temperature: -40...+100 °C (-40...+212 °F)</p>		
Position magnet		Magnet spacer		O-rings	
					
<p><b>Block magnet L</b> Part no. 403 448</p>	<p><b>Magnet spacer</b> Part no. 400 633</p>	<p><b>O-ring for threaded flange</b> M18x1.5-6g Part no. 401 133</p>	<p><b>O-ring for threaded flange</b> ¾"-16 UNF-3A Part no. 560 315</p>		
<p>Material: Plastic carrier with hard ferrite magnet Weight: Approx. 20 g Fastening torque for M4 screws: 1 Nm Operating temperature: -40...+75 °C (-40...+167 °F) This magnet may influence the sensor performance specifications for some applications.</p>	<p>Material: Aluminum Weight: Approx. 5 g Surface pressure: Max. 20 N/mm<sup>2</sup> Fastening torque for M4 screws: 1 Nm</p>	<p>Material: Fluoroelastomer Durometer: 75 ± 5 Shore A Operating temperature: -40...+204 °C (-40...+400 °F)</p>	<p>Material: Fluoroelastomer Durometer: 75 ± 5 Shore A Operating temperature: -40...+204 °C (-40...+400 °F)</p>		
O-ring		Mounting accessories			
					
<p><b>O-ring for threaded flange</b> M22x1.5-6g Part no. 561 337</p>	<p><b>Hex jam nut M18x1.5-6g</b> Part no. 500 018</p>	<p><b>Hex jam nut ¾"-16 UNF-3A</b> Part no. 500 015</p>	<p><b>Fixing clip</b> Part no. 561 481</p>		
<p>Material: FPM Durometer: 75 Shore A Operating temperature: -20...+200 °C (-6...+392 °F)</p>	<p>Material: Steel, zinc plated</p>	<p>Material: Zinc plated</p>	<p>Application: Used to secure sensor rods (Ø 10 mm (Ø 0.39 in.)) when using an U-magnet or block magnet Material: Brass, non-magnetic</p>		


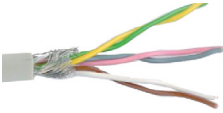
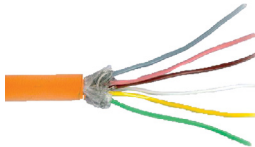
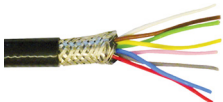
Cable connectors\*

Programming tools

			
<p><b>M16 female connector (6 pin), straight</b> Part no. 370 423</p>	<p><b>M16 female connector (6 pin), angled</b> Part no. 370 460</p>	<p><b>TempoLink kit for Temposonics® R-Series V</b> Part no. TL-1-0-AD60 (for D60) Part no. TL-1-0-AS00 (for cable outlet)</p>	<p><b>Hand programmer for analog output</b> Part no. 253 124</p>
<p>Material: Zinc nickel plated Termination: Solder Cable Ø: 6...8 mm (0.24...0.31 in.) Operating temperature: -40...+100 °C (-40...+212 °F) Ingress protection: IP65/IP67 (correctly fitted) Fastening torque: 0.6 Nm</p>	<p>Material: Zinc nickel plated Termination: Solder Cable Ø: 6...8 mm (0.24...0.31 in.) Wire: 0.75 mm<sup>2</sup> (20 AWG) Operating temperature: -40...+95 °C (-40...+203 °F) Ingress protection: IP67 (correctly fitted) Fastening torque: 0.6 Nm</p>	<ul style="list-style-type: none"> <li>• Connect wirelessly via Wi-Fi enabled device or via USB with the diagnostic tool</li> <li>• Simple connectivity to the sensor via 24 VDC power line (permissible cable length: 30 m)</li> <li>• User friendly interface for mobile devices and desktop computers</li> <li>• See product brief "TempoLink smart assistant" (document part no.: <a href="#">551976</a>) for further information</li> </ul>	<p>Easy teach-in-setups of stroke length and direction on desired zero / span positions. For sensors with 1 magnet.</p>

Programming tool

Cables

			
<p><b>Cabinet programmer for analog output</b> Part no. 253 408</p>	<p><b>PVC cable</b> Part no. 530 032</p>	<p><b>PUR cable</b> Part no. 530 052</p>	<p><b>Teflon® cable</b> Part no. 530 112</p>
<p>Features snap-in mounting on standard DIN rail (35 mm). This programmer can be permanently mounted in a control cabinet and includes a program / run switch. For sensors with 1 magnet.</p>	<p>Material: PVC jacket; gray Features: Twisted pair, shielded, flexible Cable Ø: 6 mm (0.23 in.) Cross section: 3 × 2 × 0.14 mm<sup>2</sup> Bending radius: 10 × D (fixed installation) Operating temperature: -40...+105 °C (-40...+221 °F)</p>	<p>Material: PUR jacket; orange Features: Twisted pair, shielded, highly flexible, halogen free, energy chain capable, mostly oil &amp; flame resistant Cable Ø: 6.4 mm (0.25 in.) Cross section: 3 × 2 × 0.25 mm<sup>2</sup> Bending radius: 5 × D (fixed installation) Operating temperature: -30...+80 °C (-22...+176 °F)</p>	<p>Material: Teflon® jacket; black Features: Twisted pair, shielded, flexible, high thermal resistance, mostly oil &amp; acid resistant Cable Ø: 7.6 mm (0.3 in.) Cross section: 4 × 2 × 0.25 mm<sup>2</sup> Bending radius: 8 – 10 × D (fixed installation) Operating temperature: -100...+180 °C (-148...+356 °F)</p>

\*/ Follow the manufacturer's mounting instructions

Controlling design dimensions are in millimeters and measurements in ( ) are in inches

## ORDER CODE

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	
R	H	5								0					1			0					
a			b	c	d					e		f			g	h	i	j	k	l			

optional

<b>a</b>	<b>Sensor model</b>
R H 5	Rod

<b>b</b>	<b>Design</b>
B	Base unit (only for replacement)
J	Threaded flange M22×1.5-6g (rod Ø 12.7 mm), stroke length: 25...5900 mm (1...232 in.)
M	Threaded flange M18×1.5-6g (standard)
S	Threaded flange ¾"-16 UNF-3A (standard)
T	Threaded flange ¾"-16 UNF-3A (with raised-face)

<b>c</b>	<b>Mechanical options</b>
A	Standard
B	Bushing on rod end (only for design »M«, »S« & »T«)
M	Thread M4 at rod end (only for design »M«, »S« & »T«)
V	Fluorelastomer seals for the sensor electronics housing

<b>d</b>	<b>Stroke length</b>
X X X X M	0025...7620 mm
	<b>Standard stroke length (mm)</b>
	<b>Ordering steps</b>
	25... 500 mm      5 mm
	500... 750 mm      10 mm
	750... 1000 mm      25 mm
	1000... 2500 mm      50 mm
	2500... 5000 mm      100 mm
	5000... 7620 mm      250 mm
X X X X U	001.0...300.0 mm
	<b>Standard stroke length (in.)</b>
	<b>Ordering steps</b>
	1... 20 in.      0.2 in.
	20... 30 in.      0.4 in.
	30... 40 in.      1.0 in.
	40... 100 in.      2.0 in.
	100... 200 in.      4.0 in.
	200... 300 in.      10.0 in.
	Non-standard stroke lengths are available; must be encoded in 5 mm/0.1 in. increments.

<b>e</b>	<b>Number of magnets</b>
0 X	01...02 Position(s) (1...2 magnet(s))

<b>f</b>	<b>Connection type</b>
D 6 0	M16 male connector (6 pin)
H X X	XX m PUR cable (part no. 530 052) H01...H30 (1...30 m/3...99 ft.) See "Frequently ordered accessories" for cable specifications
R X X	XX m PVC cable (part no. 530 032) R01...R30 (1...30 m/3...99 ft.) See "Frequently ordered accessories" for cable specifications
T X X	XX m Teflon® cable (part no. 530 112) T01...T30 (1...30 m/3...99 ft.) See "Frequently ordered accessories" for cable specifications
	*/ Encode in meters if using metric stroke length. Encode in feet if using US customary stroke length

<b>g</b>	<b>System</b>
1	Standard

<b>h</b>	<b>Output</b>
A	Current
V	Voltage

<b>i</b>	<b>Function</b>
1	Position (1 or 2 magnets/outputs)
2	Position and speed (1 magnet and 2 outputs)
3	Position and velocity (1 magnet and 2 outputs)
4	Position and reverse position (1 magnet and 2 outputs)
5	Position and temperature inside the sensor electronics housing (1 magnet and 2 outputs)
6	Differential (2 magnets and 1 output)

<b>j</b>	<b>Options</b>
0	Standard

<b>k</b>	<b>Output range</b>
0	0...10 VDC or 4...20 mA
1	10...0 VDC or 20...4 mA
2	-10...+10 VDC or 0...20 mA
3	+10...-10 VDC or 20...0 mA



**I Max speed or velocity value**

(optional: use when **i** "Function" is 2 or 3)

For metric stroke lengths encode speed in m/s for the values 0.01 to 9.99 m/s (001...999)  
For US customary stroke lengths encode speed in inches/s for the values 1 to 400 in./s (001...400)

Use the codes (00E) for 0.025 m/s, and (A00) for 10.0 m/s to provide backwards compatibility for these old R-Series selections

**NOTICE**

- Specify number of magnets for your sensing application and order separately.
- The number of magnets is limited by the stroke length. The minimum allowed distance between magnets (i.e. front face of one to the front face of the next one) is 75 mm (3 in.).
- Use magnets of the same type for multi-position measurement, e.g. 2 × U-magnet (part no. 251 416-2).

**DELIVERY**



- RH5-B:**
- Base unit (without flange/rod assembly)
  - 3 socket screws M4

- RH5-J/-M/-S/-T:**
- Sensor
  - O-ring
- Accessories have to be ordered separately.

Manuals, Software & 3D Models available at:  
[www.mtssensors.com](http://www.mtssensors.com)

**GLOSSARY**

**A**

**Analog output**  
For a sensor with analog output, the measured value is output as an analog voltage signal or current signal.

**D**

**Differential**  
For differential measurement, the distance between the two position magnets is output as a value.

**M**

**Max speed or velocity value**  
For speed or velocity, the output value generated is scaled based on the maximum speed or velocity value indicated in the sensor's model number.

**Measuring direction**  
When moving the position, the position and velocity values increase in the measuring direction.

- Forward: Values increasing from sensor electronics housing to rod end/profile end
- Reverse: Values decreasing from sensor electronics housing to rod end/profile end

**Multi-position measurement**  
During the measurement cycle, the positions of every magnet on the sensor are simultaneously reported. The velocity or speed is continuously calculated based on these changing position values as the magnets are moved.

**R**

**Resolution**  
The sensor precisely measures time to provide the position measurement. For the analog output the measured time value is converted into an analog voltage signal or current signal using a high-performance Digital to Analog Converter (DAC) having 16 bits of resolution.

**S**

**Speed**  
The output value for speed indicates how fast the position magnet is being moved, independent of the measuring direction. (→ Velocity)

**T**

**Temperature inside the sensor electronics housing**  
The temperature inside the sensor electronics housing is reported as an analog voltage signal or current signal. For each output range, the 0 % output value has the factory default setpoint at -40 °C, and the 100 % output value has the default setpoint at 100 °C.

**V**

**Velocity**  
The output value for velocity indicates how fast the position magnet is being moved, and in which direction. (→ Speed)

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